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UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF CALIFORNIA

PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS, *et al.*,

Plaintiffs,

v.

WILBUR ROSS, *et al.*,

Defendants.

Case No. 1:20-cv-00431-DAD-SAB

DECLARATION OF KRISTIN WHITE

I, Kristin White, declare as follows:

1. I am employed by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) located in Sacramento, California. I am the Operations Manager of Reclamation's Central Valley Operations Office (CVO), and I have held that position since October 2019. Prior to that, I was employed by Reclamation as the Deputy Operations Manager of CVO.

2. I have a Bachelor of Science degree in Civil Engineering from Florida Institute of Technology in Melbourne, Florida and a Master of Engineering in Civil Engineering with a focus in water resources and hydrosystems from the University of Houston in Houston, Texas.

3. As Operations Manager of CVO, I oversee the daily operations of the Central Valley Project (CVP), including Shasta Dam on the Sacramento River, Trinity Dam on the Trinity River, the trans-basin diversion through Whiskeytown Reservoir, Folsom Dam on the American River, New Melones Dam on the Stanislaus River, and the Jones Pumping Plant in the Delta. I am familiar with the operation of the CVP for authorized purposes under biological opinions issued by the U.S. Fish and Wildlife Service (FWS) in 2008 (2008 FWS BiOp) and the National Marine Fisheries Service (NMFS) in 2009 (2009 NMFS BiOp) (collectively, the "2008/2009 BiOps"). My office coordinates its operation of the CVP with the Department of Water Resources' (DWR) operation of the State Water Project (SWP).

4. I am also familiar with Reclamation's October 21, 2019, biological assessment for the Reinitiation of Consultation on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (ROC BA). I am also familiar with biological opinions issued by FWS and NMFS in 2019 for the Reinitiation of Consultation on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (ROC BiOps). Those opinions concluded that the Proposed Action in the ROC BA would not jeopardize the continued existence of listed species or modify or destroy the critical habitat of any listed species.

5. On December 19, 2019, Reclamation issued a final environmental impact statement (EIS) for the Reinitiation of Consultation on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project. Alternative 1 of that EIS analyzed proposed operations under the ROC BA and ROC BiOps. Reclamation included a copy of the ROC BA in the ROC EIS as Appendix AB.

6. On February 18, 2020, Reclamation issued a Record of Decision (ROD) authorizing implementation of the Alternative 1 of the ROC EIS, which analyzed operations under the ROC BA and the ROC BiOps. I am familiar with the ROC EIS and ROD.

7. Reclamation is currently operating the CVP consistent with the ROD and ROC BiOps. Reclamation prepared two tables, entitled "Reinitiation of Consultation," that depict CVP operations under the ROC BiOps. Those tables provide a broad overview of operations under the ROC BiOps, but actual CVP operations may be driven by State Water Resources Control Board (SWRCB) Decision 1641 (D-1641) or other requirements. (Attach. 1).

8. I have also read Plaintiffs' Motion for Preliminary Injunction filed in the above-captioned proceeding. It is my understanding that Plaintiffs' challenge the validity of the ROC BiOps and Reclamation's reliance on the ROC BiOps for CVP operations. It is also my understanding that Plaintiffs asked the court to require Reclamation to operate the CVP under the 2008/2009 BiOps until this case is resolved on the merits.

CVP Forecasts and Allocations

9. Each month my office performs operations forecasting on a 12-month ahead cycle to determine how the available water resources can best be used to meet project objectives and requirements, which include considerations for health and safety, fishery, water quality, other environmental requirements, and water contracts. (ROC BA at 4-15 to 4-16). Reclamation bases forecasts on projected runoff volumes that would occur naturally and considers potential upstream operations where relevant. Runoff forecasts, developed by DWR and the National Weather Service, are used to estimate the inflow for the February through September period, and historical hydrology is used to estimate the inflow for the next water year (starting in October).

10. CVO forecasts of CVP operations include a 50 percent exceedance forecast and a more conservative, drier, 90 percent exceedance forecast. With the 50 percent exceedance forecast, there is a 50 percent chance that hydrology in the CVP will be drier than

assumed in the forecast. With the 90 percent exceedance forecast, there is a 10 percent chance that hydrology will be drier in the CVP than assumed in the forecast.

11. From February 10 to 14, 2020, Reclamation prepared a February forecast of CVP operations including a 50 percent exceedance forecast and a 90 percent exceedance forecast. (Attach. 2). On February 25, 2020, Reclamation announced its initial 2020 water supply allocation for CVP contractors. (Attach. 3). Allocation amounts are based on an estimate of water available for delivery to CVP water users throughout the contract year and reflects current reservoir storages, precipitation, and snowpack in the Central Valley and Sierra Nevada. The methodology used to calculate the initial allocations was the same methodology used under the operations of the 2008/2009 BiOps. The initial allocations were based on the 90 percent exceedance forecast, which was based on hydrologic conditions as of February 1, 2020.

12. In the initial allocation notice, North-of-Delta agricultural water users were allocated 50% of their Contract Totals (consistent with Section 4005(e) of the Water Infrastructure Improvements for the Nation (WIIN) Act, while South-of-Delta agricultural water users were allocated 15% of their Contract Totals. South-of Delta water users depend on water exported from the Delta into San Luis Reservoir to meet their demands. Reclamation shares the available storage at San Luis Reservoir with DWR. The 50 percent exceedance forecast for February shows that the Federal share of storage at San Luis Reservoir is positive throughout the year. The 90 percent exceedance forecast for February shows the Federal share of San Luis Reservoir with a negative storage in July and August, but due to the drastic change in hydrology between January and February, the forecast did not fully account for accretions and depletions in the Sacramento River. Under the February forecast, those accretions and depletions were expected to result in additional storage in San Luis Reservoir without any modifications to reservoir releases, which could be used to meet South-of-Delta demands.

13. Certain CVP contracts, such as Sacramento River Settlement (SRS) Contracts, Exchange Contracts, and Refuge Contracts, include a "Shasta Critical" provision, which dictate an

automatic reduction in water made available by Reclamation in a Critical Year, which occurs when Shasta inflows are less than 3.2 million acre-feet (MAF). In February, the expected unimpaired inflows into Shasta were greater than 3.2 MAF, so the initial estimate of water to be made available to those contractors was 100 percent of their Contract Totals.

14. Subsequent to the February forecast, the month of February ended up being the driest on record with inflow tracking well below the 90% exceedance forecast. This resulted in a major change in the forecast between February and March. On March 9, 2020, DWR released its March inflow forecast, including a 90 percent exceedance forecast. (Attach. 4). In the March 90 percent exceedance forecast, inflows into Shasta are 3.11 MAF, however, in the 50 percent exceedance forecast, they are above 3.2 MAF. In addition, several storms were forecasted in mid-March which could have shifted this inflow estimate. Reclamation will continue to monitor inflows into Shasta during the month of March, and determine whether Shasta inflows dictate a Shasta Critical designation in early April. On or about March 11, 2020, Reclamation informed potentially affected contractors that the water year may be revised to Shasta Critical. If the year turns out to be Shasta Critical, then the affected contractors will be notified of any reduction in the amount of water made available to them consistent with the terms of their contracts. For most of those contractors, that would mean a 25 percent reduction in the amount of water made available to them by Reclamation.

15. Conditions remained relatively dry in the Central Valley during March and the storms that did develop did not change the overall dry conditions. On March 25, 2020, Reclamation released its March forecast, including a 90 percent exceedance forecast and a 50 percent exceedance forecast (Attach. 5). Under the 90 percent exceedance forecast, the Federal share of San Luis Reservoir will have a negative storage throughout the summer and into the fall (from June to November), assuming a 15% allocation to South-of Delta agricultural water users. Reclamation does not plan to have a negative storage in San Luis Reservoir; however the forecast this early in the season is intended to show the

risk to the existing allocation should conditions not change drastically. There are two main areas that could improve the San Luis storage conditions: (1) a large increase in precipitation in late March and April that results in additional water available for exporting both in the spring and throughout the summer, or (2) continued dry conditions that result in a Shasta critical determination which reduces the deliveries to certain contracts. Due to the uncertainty in either of these conditions, Reclamation did not provide an allocation update in March. Reclamation continues to monitor the situation, but Reclamation may need to reduce CVP allocations if conditions continue to project a negative San Luis storage. Reclamation expects to make that determination in mid-April, 2020.

16. The allocation process remains largely the same as it was under the 2008/2009 BiOps with the exception of requesting approval for a preliminary temperature management plan. Under the 2008/2009 BiOps Reclamation would send a preliminary temperature management plan for Shasta to NMFS in February, prior to making the initial allocation announcement. However, because Shasta Lake does not stratify until later in the year, the early-season plans sent under the 2008/2009 BiOps incorporated significant uncertainty and did little to assist in early season temperature management nor modify early CVP season operations. As discussed below, Reclamation will develop a preliminary temperature management plan for Shasta Dam and the Sacramento River in April with a final plan in May when cold water behind Shasta Dam has likely stratified. This timing allows for accurate information to predict available cold water and to plan gate operations and releases that use the available cold water to achieve temperatures that reduce mortality of Winter-run Chinook salmon during egg incubation.

17. The initial allocation announcement in February did not change the criteria controlling the operation of the CVP for the remainder of February and has not changed operations to the present. Reclamation continued to operate the CVP in the same manner, for the same authorized purposes, and consistent with applicable law and existing contracts, just as it did prior to the announcement. Additionally, the majority of CVP contract deliveries

begin after May 1, so any changes to allocations in March or April have little to no effect on CVP operations. Reclamation will continue to monitor conditions within the CVP and will update allocations, as appropriate, consistent with the terms of the contracts.

Shasta Operations

18. Reclamation operates Shasta Dam on the Sacramento River. Shasta Dam is equipped with a temperature control device (TCD) that allows Reclamation to control the elevation of the water released from Shasta Dam and thereby modify the ultimate release temperature. The TCD has four levels of gates from which water can be drawn: upper gates, middle gates, PRG gates (e.g., lower gates) and the Side Gates (coldest configuration). (ROC BA at 4-26).

19. During mid-winter and early spring, the highest possible elevation gates of the TCD are utilized to draw from the upper portions of the lake to conserve deeper colder resources. During late spring and summer, the operators begin the seasonal progression of opening deeper gates as Shasta Reservoir elevation decreases and cold water resources are utilized. In late summer and fall, the TCD side gates are opened to utilize the remaining cold water resource. (ROC BA at 4-27).

20. From now until May 15, 2020, Shasta operations are expected to be driven by minimum flows for riparian water users, outflow requirements under SWRCB D-1641 and contractor demands. During that period, the minimum flow requirements and outflow requirements are the same under both the ROC BiOps and 2008/2009 BiOps. The water supply diversions expected prior to May 15th are primarily for the SRS Contractors, which would be diverting Base Supply, which is grounded in their senior water rights. In my opinion, Shasta operations prior to May 15, 2020 would be the same under the ROC BiOps and the 2008/2009 BiOps.

21. The ROC BiOps allow for a spring pulse flow of up to 150 TAF if May storage is high and the action would not cause a shift to a lower temperature management tier. (ROC BA at 4-28). For 2020, the projected May 1 storage at Shasta is not high enough to allow for a pulse flow, so there is no spring pulse flow scheduled from Shasta Reservoir in

2020. This helps to preserve the cold water pool for use later in the temperature management season.

22. In April, Reclamation will prepare and transmit a draft temperature management plan for Shasta Reservoir and the Sacramento River to the Sacramento River Temperature Task Group (SRTTG), which includes the FWS and NMFS, for review and technical input. Reclamation will implement the temperature management plan from May 15, 2020 through October 31, 2020, or until the SRTTG determines based on real-time monitoring that 95 percent of Winter-Run Chinook Salmon eggs have hatched, and alevin have emerged, whichever is earlier. (ROC BA at 4-30).

23. The temperature management plan for the Sacramento River, beginning May 15, will address cold water management utilizing a tiered strategy that allows for strategically selected temperature objectives, based on projected total storage and cold water pool, meteorology, Delta conditions, and habitat suitability for incorporating fish population size and location. The tiered strategy recognizes that cold water is a scarce resource and that additional measures may be required when hydrology and meteorology do not provide sufficient cold water to avoid temperature dependent mortality throughout the entire temperature management period. The tiered strategy is intended to optimize use of cold water at Shasta for Winter-Run Chinook Salmon eggs based on life-stage-specific requirements during the temperature management season. (ROC BA at 4-31 to 4-32).

24. Tier 1 years target 53.5 degrees at the Sacramento River above Clear Creek (CCR) gauge for the entire temperature management season (May 15-Oct 30); Tier 2 targets 53.5 degrees during the critical egg incubation period; Tier 3 targets 53.5-56 degrees during the critical egg incubation period and considers intervention measures; Tier 4 targets 56 degrees and considers intervention measures. (ROC BA at 4-30 to 4-35). By targeting the most critical egg incubation stages when cold water is limited, the tiered approach is anticipated to perform better than previous strategies that have either run out of cold water partway through the season (2014) or could not maintain cold enough water temperatures to support egg incubation throughout the entire period (2015).

25. Under the ROC BiOps and ROD, Reclamation will manage temperatures on the Sacramento River at a location just above the Clear Creek confluence (CCR) as a surrogate for the downstream extent of most Winter-run Chinook salmon redds. (ROC BA at 4-30). Generally, the 2009 NMFS BiOp used a warmer compliance temperature (56 degrees) and a compliance location downstream of Clear Creek. A location downstream of Clear Creek potentially incorporates warmer inflows from tributaries to the Sacramento River. Reclamation would need to release additional cold water to cool those tributary inflows. Since most of the Winter-run eggs are located above Clear Creek, a temperature target located downstream of Clear Creek would cost cold water without benefiting Winter-run egg incubation.

26. Reclamation has committed that once the initial tier is selected by May 15th, it will not cause a shift into a warmer tier during real-time implementation of the Shasta Cold Water Management Plan, except in the event of responding to emergency and/or unforeseen conditions. (ROC BA at 4-36). These unforeseen circumstances include higher water quality control plan compliance requirements, significant warmer meteorology, significant changes in forecasted inflow quantities and temperatures to Shasta, facility malfunctions, and other matters out of Reclamation's control.

27. Given the dry conditions in February and March to date, I anticipate that this is likely to be a Tier 3 year, depending on the hydrology during the rest of March and early April. In Tier 3, when Reclamation determines that life-stage-specific temperature targets cannot be met (e.g., less than 2.3 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that cold water pool management at colder tiers would cause loss of temperature control late in the season), Reclamation will use cold water pool releases to maximize Winter- run Chinook Salmon redd survival. In Tier 3, the targeted temperature at CCR during the critical egg incubation period will be as low as possible (within the range of 53.5°F – 56°F) while not exceeding 56°F during the early and late periods of cold water pool management. Additionally, if the temperature management plan indicates a higher risk of exceeding 56°F before October 1st, this is an indication

that the cold water pool may not support a warm early fall and will therefore be treated as a Tier 4 year for the purposes of intervention measures and early season discussions and coordination. (ROC BA at 4-32).

28. Reclamation will also implement performance objectives for assessing cold water management under the different tiers. The objective is to ensure that the performance falls within the modeled range and shows a tendency towards performing at least as well as the distribution produced by the simulation modeling in the ROC BA. Reclamation's objective, as described in the ROC BA, will be to meet the temperature criteria associated with each tier and that the associated biological performance will fall within the full range of modeled performance. (ROC BA at 4-36 to 4-38).

29. During the fall and winter seasons, from October through February, Reclamation will operate to rebuild Shasta storage and cold water pool for the subsequent year. (ROC BA 4-38 to 4-39). Reclamation will implement several operational components that are intended to contribute to increased spring Shasta storage levels as compared to the conditions under the 2008/2009 BiOps. These include: Fall and Winter Refill and Redd Maintenance, which sets late fall and winter flow targets, modification of rice decomposition operations; and December 2018 changes to the Coordinated Operating Agreement (COA) with DWR for the SWP (discussed below). Additional measures including modified fall outflow requirements and flexibility in export operations in April and May (which may relieve summer deliveries), are not likely this year given the expected hydrology. (ROC BA at 4-29).

30. This year, Reclamation and DWR are implementing amendments to the COA made through the December 2018 COA addendum. (ROC BA at 4-8). Those amendments include reducing Reclamation's share of contributions to Delta outflow requirements in drier years. More of the Delta outflow and salinity requirements are met by the State through reduced exports at the State Pumping Facilities and releases from Oroville reservoir. It also results in less reliance on releases from Shasta and Folsom Reservoirs. In drier years, such as 2020, these outflow and salinity requirements can control reservoir

releases in the late winter and early spring when Shasta Reservoir would otherwise build storage and corresponding cold water pool. Lower releases from Shasta Reservoir preserve more water for cold water pool management in the summer and early fall. In addition, the COA addendum modified the sharing of export capacity when exports are restricted. This allows for increased exports for the Federal system under certain conditions which can be stored in San Luis Reservoir in the winter and spring and used to meet non-discretionary deliveries that would otherwise rely more heavily on storage releases later in the summer.

31. In Tier 3 and 4 water years, Reclamation will "meet and confer" with FWS, NMFS, DWR, California Department of Fish and Wildlife (CDFW), and the SRS Contractors on voluntary measures to be considered if drought conditions continue into the following year. (ROC BA at 4-89). The SRS Contractors have committed to meet and confer with Reclamation, NMFS, and other appropriate agencies to determine if there is any role for the SRS Contractors in connection with Reclamation's operational decision-making for Shasta Reservoir operations during those drier water years with operational conditions as described in Tier 3 or Tier 4. (ROC BA at 4-89). The types of actions that may be considered include, but are not necessarily limited to: (1) modifying the scheduling of spring diversions by the SRS Contractors; (2) voluntary, compensated water transfers by the SRS Contractors subject to Reclamation approval; and (3) delayed SRS Contractor diversion for rice straw decomposition during the fall months. Reclamation initiated those discussions with the SRS Contractors on March 20, 2020.

32. Reclamation will implement additional measures when environmental conditions and water operations cannot fully meet the requirements of Winter-run Chinook salmon with increased used of the Livingstone Stone National Fish Hatchery conservation production, adult rescue, trap and haul, and development of a drought and dry year toolkit. (ROC BA at 4-42 and 4-89)

Stanislaus Operations

33. Reclamation operates New Melones Dam on the Stanislaus River. Below New Melones Dam are Tulloch Dam and Goodwin Dam, which is the main water diversion point on the Stanislaus River. Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID) hold senior water rights and manage the Tulloch and Goodwin Dam infrastructure through separate agreements with both Reclamation and Reclamation's CVP water service contractors (Stockton East Water District and the Central San Joaquin Water Conservation District) to meet Reclamation's Stanislaus River objectives, CVP contractor deliveries, and deliveries to the OID and SSJID service areas. (ROC BA at 4-80).

34. Under the ROC BiOps, Reclamation will operate New Melones Reservoir (as measured at Goodwin Dam) in accordance with a Stepped Release Plan (SRP) that varies by hydrologic condition/water year type. (ROC BA at 4-81). New Melones releases flows downstream of Goodwin Dam for specific requirements, primarily the SRP. New Melones is not operated to release for CVP exports at the Jones Pumping Plant.

35. Under the 2009 NMFS BiOp, along with numerous other layered requirements, the New Melones operation was unsustainable due to release requirements being higher than the average annual inflow to the reservoir. This resulted in drawing down the reservoir more often than it's filling and lead to low reservoir storage. The SRP was developed with the primary goal to improve the sustainability and therefore increase the average storage volume. Although New Melones Dam is not equipped with a temperature control device and there is no way to manage release temperatures, higher storage generally results in lower release temperatures.

36. The New Melones SRP will be implemented similarly to operations under the 2009 NMFS BiOp with a default daily hydrograph, and the ability for a mutli-agency team (the Stanislaus Watershed Team) to shape monthly and seasonal flow volumes to meet specific biological objectives. The Stanislaus Watershed Team meets at least monthly to review the daily hydrograph for the next month (or longer if appropriate) and determine if any of the flow volumes should be reshaped to meet various biological objectives.

37. Under the ROD and ROC BiOps, for the New Melones SRP, Reclamation will classify water year types using the San Joaquin Valley "60-20-20" Water Year Hydrologic Classification (60-20-20) developed for D-1641 implementation. (ROC BA at 4-81). Previous operating plans for New Melones Reservoir relied on the New Melones Index (NMI) to determine water year type, but changing from the NMI to the 60-20-20 is expected to provide operations that better represent current hydrology and correlate more closely to water year types for other nearby tributaries. (ROC BA at 4-82).

38. Currently, Reclamation is implementing the New Melones SRP under a critical year water year type based on the DWR March forecast. This requires minimum releases of 200 cfs with a small pulse flow in the spring that can be shaped by the Stanislaus Watershed Team. Later this spring, Reclamation may need to increase releases to implement base flow requirements under SWRCB D-1641. Reclamation expects that summer releases will be a minimum of 150 cfs, or the releases required to meet the Vernalis salinity objective in D-1641 and the dissolved oxygen requirement in SWRCB Decision-1422, as updated by D-1641. The objectives under D-1641 and D-1422 were also in place under the 2009 NMFS BiOp.

39. The critical year minimum flows in the SRP are identical to those in the 2009 NMFS BiOp, Appendix 2E; however, the water year type is defined differently. The water year type under the 2009 NMFS BiOp would likely have been dry based on the March forecast, but the new water year type, which better matches with the actual hydrology in the basin, is critical. This results in lower minimum releases down the Stanislaus River, particularly in the spring, unless more water needs to be released to meet dissolved oxygen or salinity objectives at Vernalis. This modification helps to conserve storage when the hydrology does not support the higher releases and result in better overall temperatures from the reservoir.

Delta Operations

40. Reclamation operates the Jones Pumping Plant in the Delta to deliver water for authorized purposes south of the Delta. DWR operates the Harvey O. Banks Pumping

Plant, also in the Delta. Authorized uses of the Jones Pumping Plant include irrigation water supply, municipal and industrial water supply, and refuge water supply. Reclamation will operate the CVP facilities in a manner that maximizes exports while minimizing entrainment of fish and protecting critical habitat. Generally, net flow in Old and Middle Rivers (OMR), which are located near the two pumping plants, provide a surrogate indicator for how export pumping influences hydrodynamics in the south Delta. (ROC BA at 4-66).

41. From the onset of OMR management to the end (see below), Reclamation will operate to an OMR index no more negative than a 14-day moving average of -5,000 cfs unless a storm event occurs. Studies indicate that -5,000 cfs is an inflection point in OMR for fish entrainment. OMR will be more positive than -5,000 cfs even during storm events, when additional real-time OMR restrictions are triggered or exports are controlled by constraints other than OMR. (ROC BA at 4-67).

42. Under the ROC BiOps, Reclamation will implement Additional Real-Time OMR Restrictions and Performance Objectives. (ROC BA at 4-67 to 4-71). That includes provisions for adjusting Delta operations to protect Delta smelt and additional provisions to provide for the protection of listed salmon and steelhead, including Single Year Thresholds and Cumulative Loss thresholds. Single-year thresholds allow flexible operations within sideboards that are less than historical measured incidental take. Actions that support the seasonal migration of salmon through the Delta avoid the potential for entrainment into the south Delta and reduce the likelihood of detecting listed species in salvage facilities prior to entering the CVP and SWP pumps. The sideboards require pumping restrictions to result in OMR at or more positive than -3,500 cfs upon reaching 50% of the single-year threshold and export restrictions at or more positive than -2,500 cfs upon reaching 75% of the single-year threshold. These restrictions last throughout the remainder of the season for the applicable species in order to provide protection for the rest of the migration season. (ROC BA at 4-70)

43. The single-year thresholds set a clear limit that, if reached, could result in significant export reductions for many months. This limit encourages proactive export reductions taken to avoid hitting the single-year threshold and would be focused on occurring before a large portion of fish are detected in salvage and before a portion of the population is already within the south Delta. Should the single-year thresholds be met, the export reduction lasts throughout the relevant species' season. The density dependent triggers of the 2009 NMFS BiOp required short-term reductions following high salvage events, meaning a portion of the fish were already in the south Delta, regardless of export changes. That action did not result in an export reduction before listed fish were in the south Delta near the pumps.

44. Natural Central Valley Steelhead are separated into two time periods (December – March and April – June) to protect San Joaquin Origin fish that historically appear in the Mossdale trawls later than Sacramento origin fish. (ROC BA 4-69). The Cumulative Loss Threshold and the Single-Year Loss Threshold for April through June replaces the San Joaquin inflow to export (I:E) ratio from the 2009 NMFS BiOp with a measure more specific to the effects of the CVP and SWP. (ROC BA 4-20). The San Joaquin I:E ratio set export limits based on flows at Vernalis without considering other inflows, diversions, and tidal cycles in the Delta. Flows at Vernalis are one of the factors affecting OMR, but using OMR directly is a more specific method for representing the hydrodynamic influence of the CVP and SWP.

45. Reclamation and DWR will implement "OMR Management," including the "Onset of OMR Management," "Additional Real-Time OMR Restrictions and Performance Objectives," "Storm-Related Flexibility," and "End of OMR Management," which will be supported by a weekly assessment prepared by Reclamation and DWR; modified with technical assistance from NMFS, FWS, and the California Department of Fish and Wildlife (CDFW) through a Smelt Monitoring Team and a Salmon Monitoring Team; and vetted by agency managers at a Water Operations Management Team (WOMT) consisting of representatives from CDFW, DWR, FWS, NMFS, and Reclamation. If there

is not agreement among the WOMT members, any member of WOMT may elevate an intended operational action to the Directors of the 5 Agencies who would then meet and make a decision consistent with their respective authorities, including Reclamation's responsibility in operating the CVP, DWR's responsibility in operating the SWP, FWS' responsibility for Delta Smelt under the ESA, NMFS' responsibility for salmon, steelhead and sturgeon under the ESA, and CDFWs responsibility under the California Endangered Species Act (CESA).

46. OMR Management would continue until June 30 (for Delta Smelt and Chinook salmon), until June 15 (for steelhead/rainbow trout), or when the following species-specific off ramps have occurred, whichever is earlier:

- Delta Smelt: when the daily mean water temperature at Clifton Court Forebay (CCF) reaches 77°F for 3 consecutive days;
- Salmonids:
  - o when more than 95 percent of salmonids have migrated past Chipps Island, as determined by their monitoring working group, or
  - o after daily average water temperatures at Mossdale exceed 71.6°F for 7 days during June (the 7 days do not have to be consecutive). (ROC BA at 4-71)

47. Consistent with Section 4003 of the WIIN Act, Reclamation and DWR may operate to a more negative OMR up to a maximum (otherwise permitted) export rate at Banks and Jones Pumping Plants of 14,900 cfs (which could result in a range of OMR values) to capture peak flows during storm-related events under the storm flexibility action. The implementation of a more negative OMR relies on a number of factors including: 1) meeting the definition of a storm event by precipitation falling in the Central Valley and Delta watershed, and Reclamation and DWR determining that the Delta outflow index indicates a higher level of flow available for diversion; 2) no Integrated Early Winter Pulse Protection ("First Flush") nor other Additional Real-Time OMR restrictions in place for any species; 3) no evaluation of environmental and biological conditions that indicates more negative OMR would likely cause Reclamation and DWR to trigger an

Additional Real-Time OMR restriction; 4) no salvage of yearling Coleman National Fish Hatchery late-fall run Chinook salmon surrogates exceeding 0.5% within any of the release groups; and 5) no identification of changes in spawning, rearing, foraging, sheltering, or migration behavior beyond those anticipated to occur under OMR management. (ROC BA page 4-71). If all conditions are met, then Reclamation and DWR may operate to the more negative OMR that is defined by a risk analysis of meeting any of the above criteria, and may still be limited by facility capacities and other requirements, e.g. D-1641. Reclamation and DWR will continue to monitor fish in real-time and will operate in accordance with "Additional Real- time OMR Restrictions." Thus, while Storm-Related OMR actions are authorized under WIIN and could occur each year, they will not necessarily occur during every storm event and the operation will be limited based on the analyses described above.

48. Reclamation has not implemented any Storm-Related OMR Flexibility actions, as described above, in 2020. It is unlikely that Reclamation will implement this provision in 2020 during the OMR management season given other restrictions in place, primarily the larval/juvenile smelt action. Should storm flexibility be implemented, Reclamation would be entitled to export 60% of the available excess water under the amended COA while DWR can export the other 40% until the CVP is at maximum capacity. It is unclear if DWR would be able to implement any storm-related action due to its obligations under CESA. Reclamation has sent a memorandum to FWS explaining how Reclamation will operate the CVP for this year during the larval/juvenile season (approximately from late-March to June). (Memorandum from Mr. Ernest Conant, Regional Director, Reclamation to Mr. Paul Souza, Regional Director, FWS, dated March 13, 2020 (Attach. 6)).

49. Currently, the ROC BiOps are not controlling Delta operations. Due to the recent dry hydrology, the CVP and SWP are operating exports primarily to meet Delta outflow and salinity objectives and to provide the minimum amount of water required for public health and safety, which is about 1,500 cfs. Towards the end of February, Reclamation

and DWR were at minimal pumping along with some elevated storage releases to meet Delta outflow objectives. In March, the outflow requirement decreased, and allowed opportunities for both decreases in upstream releases for storage conservation and limited increased pumping, although this was still well below the limitations set in either the 2019 BiOps or the 2008/2009 BiOps. If the dry hydrology persists, it is anticipated that pumping will be reduced back to the minimum value of 1,500 cfs in April and May. Given the unsettled weather and small intermittent storm events, there may be opportunities for short term increases in exports to pick up additional runoff. Depending on the location of the storm, this flexibility may exist under both the 2019 BiOps and the 2008/2009 BiOps. This opportunity is expected to decrease as we move into April and May due to an expected increase in basin-wide depletions. In addition, D-1641 requires a maximum pumping ratio of 1:1 with Vernalis flows from April 15-May 15. This ratio is the same that is expected under the I:E ratio from the 2009 NMFS BiOp. In other words, whether Reclamation implemented the I:E ratio in the 2008/2009 BiOps or the OMR Management provisions of the ROC BiOps, the operation in the Delta are expected to be similar across April and May.

50. If dry hydrological conditions continue, Reclamation expects to continue lower export operations through June. It's likely that, in order to meet Delta outflow requirements and demands, Reclamation and DWR will begin making storage releases that will be used to support Delta outflow and deliveries both upstream to various contractors and south of the Delta through the export facilities and subsequent infrastructure.

51. There are infrastructure limitations on exporting water from the Delta. Given recent subsidence within the Delta Mendota Canal, the maximum export capacity ranges from approximately 4,100 cfs to 4,400 cfs, depending on demands in the canal and capacity to move water into San Luis Reservoir. Generally, we assume a capacity of 4,300 cfs in the spring and winter when direct demands are low and 4,400 cfs in the summer when demands are high. The planned capacity of the plant was 4,600 cfs. Due to the

additional limited capacity of a portion of the DMC, exports beyond around 3,700 cfs require operation of the Delta Mendota Canal/California Aqueduct Intertie.

Delta Outflows

52. Reclamation will implement the Delta Smelt Summer-Fall Habitat Action to benefit Delta smelt in the summer and fall (June through October) of below normal, above normal and wet years, based on the Sacramento Valley Index. (ROC BA at 4-72). This action recognizes that the highest quality habitat in this large geographical region includes areas with complex bathymetry, in deep channels close to shoals and shallows, and in proximity to extensive tidal or freshwater marshlands and other wetlands.

53. This action will provide these habitat components in the same geographic area through a range of actions to improve water quality and food supplies. That includes modifying project operations to maintain a monthly average 2 parts per thousand isohaline at 80 km from the Golden Gate in above normal and wet water years in September and October. It includes operation of the Suisun Marsh Salinity Control Gates to increase the habitat area meeting low salinity conditions, and also includes implementation of additional measures that are expected to achieve additional benefits for food enhancement and cover. Reclamation and DWR will develop a Delta Smelt Summer-Fall Habitat Action Plan to meet the environmental and biological goals in years when summer-fall habitat actions are triggered. (ROC BA at 4-72 to 4-74). Due to the dry hydrology, it is unlikely this action will occur this year due to the year type being either dry or critical.

54. Under the 2008 FWS BiOp, Reclamation was required to implement a Fall X2 Action for Delta smelt in wet and above-normal years. Due to the dry hydrology, Reclamation would not implement the Fall X2 Action under the 2008 FWS BiOp, if it were in effect. In the unlikely event the water year type increases to below normal, this would result in a protective action for Delta smelt that exists in the ROC BiOp, but not the 2008/2009 BiOps.

55. Additionally, as explained above, due to the current expected hydrology, Reclamation does not expect outflow to decrease due to elimination of the I:E ratio in the 2009 NMFS

BiOp. In addition, D1641 requires a maximum pumping ratio of 1:1 with Vernalis flows from April 15-May 15. This ratio is the same that is expected under the I:E ratio from the 2009 BiOp. Thus, elimination of the I:E ratio should have no effect Delta outflows this year.

56. Reclamation and DWR will operate to the Delta outflow requirements under D-1641, which, for 2020, are the same outflow requirements that existed under the 2008/2009 BiOp. If the system is balanced, meaning the flow in the system matches the required outflow, then the export restrictions are typically not limiting operations and therefore do not change the outflow. The current projections for 2020 project balanced conditions in April and May and therefore the outflow during these months would be the same regardless of the BiOp conditions.

Pursuant to 28 U.S.C. § 1746, I declare under the penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on March 26, 2020, in Sacramento, California.

KRISTIN WHITE

ATTACHMENT 1

Reinitiation of Consultation

March 18, 2020

Solid fill indicates likely time-period of action; Shaded fill indicates potential time-period of action.

Division	Action	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Upper Sacramento /Shasta Division	Cold water pool management[1]	Oct 1 - Oct 31							May 15 - Sep 30				
	Spring Pulse Flows						Mar 1 - April 30						
	Fall and Winter Refill and Redd Maintenance	Oct 1 - Feb 28											
Bay-Delta Division	Delta Cross Channel Gates	Oct 1 - Jan 31 Conditional				Feb 1 - May 20 Closed				May 21 - Jun 15 Cond.			
	OMR Integrated Early Winter Pulse Protection			Dec 1 - Jan 31									
	OMR Management				Jan 1 - June 30								
	OMR Turbidity Bridge Avoidance			Dec 15 - Jan 31		Feb 1 - Mar 31							
	Delta Smelt Protection for Larval & Juvenile						March 15 - June 30						
	OMR Performance Measures	Oct 1 - Jul 31											
	Summer-Fall Delta Smelt Habitat Delta Outflow[2,3]	Oct 1 - Oct 31											Sep 1 - Sep 30
	Summer-Fall Delta Smelt Habitat SMSCG [4]	Oct 1 - Oct 31								Jun 1 - Sep 30			

Reinitiation of Consultation

Solid fill indicates likely time-period of action; Shaded fill indicates potential time-period of action.

[1]Each April, Reclamation would provide a draft temperature management plan to the SRTTG for its review and comment, consistent with WRO 90-5.

[2]Each April, Reclamation and DWR will develop a Delta Smelt Summer-Fall Habitat Action Plan to meet the environmental and biological goals in years when summer-fall habitat actions are triggered (Above Normal and Wet Years).

[3]By November 2020, through the Delta Coordination Group, Reclamation and DWR would develop a multi-year science and monitoring plan consistent with the structured decision-making models.

[4]Action would occur in Below Normal and Above Normal years. The 60 days would not necessarily be consecutive during that time period.

Reinitiation of Consultation

<table>
<tr><th>Division</th><th>Action</th><th>OCT</th><th>NOV</th><th>DEC</th><th>JAN</th><th>FEB</th><th>MAR</th><th>APR</th><th>MAY</th><th>JUN</th><th>JUL</th><th>AUG</th><th>SEP</th></tr>
<tr><td rowspan="2">American River Division[1]</td><td>Minimum Flows</td><td colspan="12">Year round based on Operations Calculations</td></tr>
<tr><td>Temperature Management[2]</td><td colspan="2">Oct 1 - Nov 30</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">May 15 - Sep 30</td></tr>
<tr><td rowspan="2">Stanislaus River Division</td><td>Dissolved Oxygen Standards</td><td colspan="12">Year round</td></tr>
<tr><td>Flows downstream of Goodwin (Stepped Release Plan)</td><td>Oct Pulse Flow</td><td colspan="5">Oct 1 - Apr 14
Base Flow</td><td>Apr 15 - May 15
Pulse Flow[3]</td><td colspan="5">May 16 - Sep 30
Base Flow</td></tr>
</table>

[1]Reclamation would complete a Hatchery Genetics Management Plan for Steelhead and a Hatchery Management Plan for Fall-Run Chinook Salmon as part of Nimbus Fish Hatchery management.

[2]Each May, Reclamation would prepare a draft temperature management plan for the summer through fall temperature management season.

[3] The dates for the spring pulse flow vary by year type and are subject to SWG scheduling

ATTACHMENT 2

Estimated CVP Operations 50% Exceedance OMR -5000

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	1998	2068	2114	2196	2034	1911	1793	1639	1491	1455	1442	1472	1527
	Elev.	2346	2349	2354	2343	2335	2326	2314	2302	2299	2298	2301	2305
Whiskeytown	207	206	206	238	238	238	238	238	238	206	206	206	206
	Elev.	1199	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199
Shasta	3482	3602	3959	4062	3981	3681	3126	2709	2549	2459	2538	2682	3043
	Elev.	1033	1046	1050	1047	1036	1013	994	987	982	986	993	1010
Folsom	487	469	552	640	692	663	540	448	360	328	313	318	362
	Elev.	413	423	433	439	435	421	410	397	392	389	390	397
New Melones	1983	1955	1958	1871	1785	1709	1639	1577	1533	1493	1510	1534	1566
	Elev.	1048	1048	1040	1032	1025	1018	1011	1007	1002	1004	1007	1010
San Luis	573	607	728	691	536	325	152	85	127	257	396	615	809
	Elev.	503	515	507	478	447	410	385	392	422	444	476	502
Total		8907	9517	9699	9268	8528	7488	6696	6297	6198	6405	6826	7513

State End of the Month Reservoir Storage (TAF)

Oroville	2204	2322	2570	2739	2700	2387	2057	1794	1610	1425	1358	1374	1546
	Elev.	812	832	845	842	817	788	762	743	722	713	715	736
San Luis	945	935	956	903	724	621	454	322	333	451	518	625	718
Total San Luis (TAF)	1518	1541	1684	1594	1260	946	606	407	459	708	914	1239	1528

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	32	258	47	28	53	52	23	18	18	18
	cfs	300	300	540	4,189	783	450	857	870	373	300	300	300
Clear Creek	TAF	11	12	13	23	17	9	9	9	12	12	12	25
	cfs	200	200	218	380	288	150	150	150	200	200	200	400
Sacramento	TAF	222	307	416	492	654	830	676	416	369	238	246	246
	cfs	4000	5000	7000	8000	11000	13500	11000	7000	6000	4000	4000	4000
American	TAF	97	108	105	108	119	184	154	149	108	105	108	108
	cfs	1750	1750	1765	1750	2005	3000	2500	2500	1750	1768	1750	1750
Stanislaus	TAF	43	32	91	76	41	15	15	15	48	12	12	14
	cfs	780	525	1537	1242	690	250	250	250	774	200	200	226
Feather	TAF	97	108	63	66	233	272	272	241	214	104	108	108
	cfs	1750	1750	1060	1070	3920	4420	4420	4050	3480	1750	1750	1750

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	0	85	61	49	121	99	100	99	23	25	9	10
Spring Crk. PP	35	110	40	40	110	90	90	90	45	20	12	19.8

Delta Summary (TAF)

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy		128	250	127	88	121	210	254	260	265	201	260	240
USBR Banks		0	0	0	0	0	15	15	15	0	0	0	0
Contra Costa		14.0	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0
Total USBR		142	263	139	101	131	236	282	289	282	219	278	254
State Export		125	167	97	61	194	153	159	236	317	239	260	155
Total Export		267	430	236	161	325	389	441	525	599	458	538	409
COA Balance		2	2	10	10	0	0	0	0	23	0	0	0
Vernalis	TAF	127	140	181	175	88	54	52	57	117	83	83	93
Vernalis	cfs	2293	2282	3038	2843	1480	884	852	956	1897	1393	1355	1511
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-3,261	-4,946	-2,284	-1,330	-4,128	-5,066	-5,727	-6,955	-7,237	-5,896	-6,723	-5,033
Computed DOI		11400	16934	11094	9777	7396	7190	5856	4421	4994	4992	8508	15519
Excess Outflow		0	5515	0	163	0	179	179	185	0	0	2505	9516
% Export/Inflow		29%	29%	23%	17%	34%	35%	42%	55%	58%	56%	49%	30%
% Export/Inflow std.		45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	804		3,864		1,466		711	
Year to Date + Forecasted % of mean	67%		70%		54%		67%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

2/14/2020

Estimated CVP Operations 90% Exceedance

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	1998	2045	2047	2009	1887	1728	1581	1406	1250	1213	1189	1199	1231
	Elev.	2344	2344	2342	2333	2321	2310	2295	2281	2277	2275	2276	2279
Whiskeytown	207	206	206	238	238	238	238	238	238	206	206	206	206
	Elev.	1199	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199
Shasta	3482	3556	3680	3764	3682	3289	2792	2434	2252	2142	2142	2226	2377
	Elev.	1031	1036	1039	1036	1020	998	981	971	965	965	970	978
Folsom	487	465	448	484	470	419	365	311	274	249	229	225	276
	Elev.	412	410	415	413	406	398	389	383	378	374	373	383
New Melones	1983	1924	1891	1821	1743	1668	1583	1512	1470	1434	1445	1459	1472
	Elev.	1045	1042	1036	1028	1021	1012	1004	1000	996	997	999	1000
San Luis	363	380	479	414	280	140	-23	-67	17	151	273	398	603
	Elev.	485	495	481	462	437	408	387	396	409	428	458	485
Total		8575	8751	8729	8299	7481	6537	5833	5501	5394	5484	5713	6166

State End of the Month Reservoir Storage (TAF)

Oroville	2204	2253	2386	2456	2367	2121	1843	1630	1589	1535	1448	1434	1577
	Elev.	806	817	823	815	794	767	745	741	734	724	723	739
San Luis	945	958	968	885	810	708	609	491	472	441	486	660	739
Total San Luis (TAF)	1308	1338	1447	1299	1089	847	586	424	489	592	760	1057	1342

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	36	92	47	28	53	52	23	18	18	18
	cfs	300	300	600	1,498	783	450	857	870	373	300	300	300
Clear Creek	TAF	11	12	13	23	17	9	9	9	12	12	12	12
	cfs	200	200	218	380	288	150	150	150	200	200	200	200
Sacramento	TAF	243	246	416	489	708	768	615	416	369	268	246	246
	cfs	4370	4000	7000	7950	11900	12500	10000	7000	6000	4500	4000	4000
American	TAF	102	108	108	108	105	95	95	78	62	59	66	61
	cfs	1829	1750	1823	1765	1758	1550	1542	1305	1004	1000	1071	1000
Stanislaus	TAF	75	48	60	39	12	12	12	12	39	12	12	13
	cfs	1350	780	1004	631	200	200	200	200	635	200	200	219
Feather	TAF	97	108	104	108	144	152	153	89	83	74	77	77
	cfs	1750	1750	1750	1750	2420	2480	2490	1500	1350	1250	1250	1250

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	8	63	120	107	125	120	121	100	23	26	12	3
Spring Crk. PP	10	70	90	90	110	110	110	90	45	20	12	10

Delta Summary (TAF)

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy		99	190	45	46	115	111	193	255	260	176	158	240
USBR Banks		0	0	0	0	0	7	7	7	0	0	0	0
Contra Costa		14.0	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0
Total USBR		113	203	57	59	125	129	213	276	277	194	176	254
State Export		139	132	18	32	20	25	30	78	76	103	215	140
Total Export		252	335	75	91	145	154	243	354	353	297	391	394
COA Balance		-21	-21	-17	-6	0	21	11	46	17	-42	-42	-42
Vernalis	TAF	145	134	119	100	43	45	40	46	108	83	83	92
Vernalis	cfs	2611	2179	2004	1631	721	737	655	772	1758	1393	1355	1504
Old/Middle River Std.													
Old/Middle R. calc.		-2,910	-3,802	-663	-997	-2,140	-2,189	-3,335	-4,825	-4,218	-3,812	-4,882	-4,848
Computed DOI		12463	9777	9901	7694	7094	4994	4002	3009	4002	4505	4506	7629
Excess Outflow		1063	1236	0	0	0	0	0	0	0	0	0	1627
% Export/Inflow		26%	35%	9%	12%	18%	20%	32%	50%	49%	46%	57%	47%
% Export/Inflow std.		45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	548		3,373		1,149		611	
Year to Date + Forecasted % of mean	45%		61%		42%		58%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

2/25/2020

ATTACHMENT 3

MENU

News & Multimedia

Reclamation / News & Multimedia / News Releases / Reclamation outlines Central Valley Project initial 2020 water allocation

NEWS & MULTIMEDIA

Reclamation outlines Central Valley Project initial 2020 water allocation

Media Contact: Shane Hunt, 916-978-5100, mppublicaffairs@usbr.gov

For Release: February 25, 2020

Sacramento, Calif. - The Bureau of Reclamation today announced the initial 2020 water supply allocation for Central Valley Project contractors. Allocation amounts are based on an estimate of water available for delivery to CVP water users and reflects current reservoir storages, precipitation, and snowpack in the Central Valley and Sierra Nevada.

"Today's allocation comes on the heels of an operations plan signed last week, underscoring the Trump administration's commitment to bringing a sustainable and reliable water supply to California's Central Valley. While that operations plan is based on the best available science and maximizes water supplies, we still face significant uncertainty due to legal challenges," **said Reclamation Commissioner Brenda Burman**. "Despite the hurdles brought on by litigation from the state and others, we remain committed to providing reliable water for families, farms, cities and the environment."

California benefited from wet weather and significant snowpack in late 2019, but precipitation and snowpack have been below average so far in 2020. The California Department of Water Resources reports that as of February 24, statewide average snow water content in the Sierras was just 41% of the April 1 average. Current Northern Sierra precipitation is about 51% of the seasonal average.

"After a promising start to our precipitation season, January and February turned much drier than average," **said Reclamation's California-Great Basin Regional Director Ernest Conant**. "Fortunately, our project reservoirs are still hovering above average thanks to the wet winter last year, but with little precipitation in the forecasts, we must remain cautious with supplies and allocations this early in the year."

Shasta Reservoir's 4.5 million acre-feet capacity represents the majority of CVP water storage. Water from Shasta is used for many purposes, including contractor supply for north and south of the Sacramento-San Joaquin River Delta, as well as ensuring adequate temperatures can be maintained downstream of the dam throughout the summer and fall for threatened and endangered species. Currently, reservoir storage is above the historic average for this time of the year. However, runoff forecasts still predict that overall storage might be limited if typical spring precipitation does not materialize.

"While we're constrained by the water nature provides, our new CVP operations plan will improve operations to maximize water supplies," **Conant said**. "We recognize the importance of providing meaningful allocations early in the year, especially for our agricultural contractors' planning needs."

Given the low snowpack and low projected runoff this spring and summer, Reclamation is announcing the following initial allocations:

North-of-Delta Contractors (Including American River and In-Delta Contractors)

- Agricultural water service contractors North-of-Delta are allocated 50% of their contract supply.
- Pursuant to Reclamation's M&I water shortage guidelines, M&I water service contractors North-of-Delta (including American River and In-Delta Contractors) are allocated 75% of their historic use or public health and safety needs.
- The Sacramento River Settlement Contractors are allocated 100% of their contract supply.

Eastside Water Service Contractors

- Eastside water service contractors (Central San Joaquin Water Conservation District and Stockton East Water District) will receive 100% of their contract total.

South-of-Delta Contractors

- Agricultural water service contractors South-of-Delta are allocated 15% of their contract supply.
- M&I water service contractors South-of-Delta are allocated the greater of 65% of their historic use or public health and safety needs.
- The San Joaquin River Exchange Contractors and San Joaquin Settlement Contractors are allocated 100% of their contract supply.

Wildlife Refuges

- Wildlife refuges (Level 2) North- and South-of-Delta, which also have allocations subject to pre-established Shasta inflow criteria, are allocated 100% of their contract supply of 422,000 acre-feet.

Friant Division

- Friant Division contractors' water supply develops in the Upper San Joaquin River Basin Watershed and is delivered from Millerton Lake through Friant Dam to the Madera Canal and Friant-Kern Canal. The first 800,000 acre-feet of available water supply is considered Class 1; and Class 2 is considered the next amount of available water supply up to 1.4 million acre-feet. Given the current hydrologic conditions, Reclamation determined that Friant Class 1 initial allocation will be 20% and Class 2 will be 0%.
- For the San Joaquin River Restoration Program, Reclamation is currently forecasting a "Critical-High" water year type, providing for 70,919 acre-feet to be used for Restoration Program purposes.

In addition to the 2020 initial CVP water allocation, several South-of-Delta and Friant Division contractors are rescheduling unused water from 2019 supplies into 2020. That water is being stored in San Luis Reservoir and Millerton Lake. The option to reschedule (carry over) water in San Luis Reservoir and Millerton Lake from one contract year to the next has been available to the water service contractors since the early 1990's. That carry over option was instituted after a series of dry years in the early 1990's to encourage conservation and best water management practices.

Reclamation notified the Sacramento River Settlement Contractors, San Joaquin River Exchange Contractors, San Joaquin Settlement Contractors, and Refuge Contractors that the forecasted inflow to Shasta Lake is currently greater than 3.2 million acre-feet and we are not currently in a "Shasta Critical" year as that term is defined in their contracts.

As the water year progresses, changes in hydrology and opportunities to deliver additional water will influence future allocations. Water supply updates will be made as appropriate and posted at https://www.usbr.gov/mp/cvp-water/index.html.

For additional information, please contact the California-Great Basin public affairs office at 916-978-5100 (TTY 800-877-8339) or email mppublicaffairs@usbr.gov.

###

Reclamation is the largest wholesale water supplier in the United States, and the nation's second largest producer of hydroelectric power. Its facilities also provide substantial flood control, recreation, and fish and wildlife benefits. Visit our website at https://www.usbr.gov and follow us on Twitter @USBR.

ATTACHMENT 4

2020 SACRAMENTO RIVER WATER YEAR FORECAST BREAKDOWN
March 1, 2020

Shasta Lake Unimpaired Inflow [taf]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY	Apr-Jul	WY % avg
99%	229	224	401	433	298	260	295	230	155	130	130	126	2,910	810	
90%	229	224	401	433	298	300	340	265	180	155	145	141	3,110	940	
75%	229	224	401	433	298	355	395	310	210	180	160	156	3,350	1,095	
50%	229	224	401	433	298	410	445	350	235	200	180	181	3,585	1,230	61%
25%	229	224	401	433	298	455	490	385	260	220	200	196	3,790	1,355	
10%	229	224	401	433	298	495	535	420	285	240	215	221	3,995	1,480	
												1966-2015 avg	5,831	1,756	

Sacramento River above Bend Bridge Unimpaired Flow [taf]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY	Apr-Jul	
99%	273	245	618	647	446	365	305	255	200	175	145	151	3,825	935	
90%	273	245	618	647	446	415	375	300	230	195	170	171	4,085	1,100	
75%	273	245	618	647	446	515	455	355	255	220	185	186	4,400	1,285	
50%	273	245	618	647	446	590	530	415	295	240	200	206	4,705	1,480	55%
25%	273	245	618	647	446	665	590	460	330	265	225	236	5,000	1,645	
10%	273	245	618	647	446	725	650	505	360	295	245	251	5,260	1,810	
												1966-2015 avg	8,544	2,421	

Feather River at Oroville Unimpaired Flow [taf]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY	Apr-Jul	
99%	98	100	327	258	180	165	170	115	70	60	55	52	1,650	415	
90%	98	100	327	258	180	225	220	150	90	70	65	57	1,840	530	
75%	98	100	327	258	180	260	270	185	105	80	70	62	1,995	640	
50%	98	100	327	258	180	290	320	220	130	90	75	67	2,155	760	49%
25%	98	100	327	258	180	340	370	250	150	100	80	72	2,325	870	
10%	98	100	327	258	180	385	415	280	165	110	90	77	2,485	970	
												1966-2015 avg	4,407	1,704	

Yuba River near Smartville plus Deer Creek Unimpaired Flow [taf]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY	Apr-Jul	
99%	30	27	141	103	75	80	105	90	30	10	6	3	700	235	
90%	30	27	141	103	75	105	140	125	42	13	8	6	815	320	
75%	30	27	141	103	75	130	180	155	55	15	10	9	930	405	
50%	30	27	141	103	75	160	215	190	65	20	12	12	1,050	490	46%
25%	30	27	141	103	75	210	245	215	75	25	15	14	1,175	560	
10%	30	27	141	103	75	245	270	240	80	30	20	19	1,280	620	
												1966-2015 avg	2,268	968	

American River below Folsom Lake Unimpaired Flow [taf]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY	Apr-Jul	
99%	18	17	151	102	77	116	155	150	40	3	0	0	830	348	
90%	18	17	151	102	77	143	185	180	50	5	0	1	930	420	
75%	18	17	151	102	77	166	230	210	58	8	1	1	1,040	506	
50%	18	17	151	102	77	200	260	245	65	10	2	2	1,150	580	44%
25%	18	17	151	102	77	240	305	285	75	13	3	3	1,290	678	
10%	18	17	151	102	77	270	350	330	85	15	4	5	1,425	780	
												1966-2015 avg	2,626	1,199	

Sacramento River Unimpaired Runoff (Northern Sierra Four Rivers or SRI) [taf]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY	Apr-Jul	
99%	420	389	1237	1111	779	726	735	610	340	248	206	206	7,005	1,933	
90%	420	389	1237	1111	779	888	920	755	412	283	243	235	7,670	2,370	43%
75%	420	389	1237	1111	779	1071	1135	905	473	323	266	258	8,365	2,836	
50%	420	389	1237	1111	779	1240	1325	1070	555	360	289	287	9,060	3,310	51%
25%	420	389	1237	1111	779	1455	1510	1210	630	403	323	324	9,790	3,753	
10%	420	389	1237	1111	779	1625	1685	1355	690	450	359	351	10,450	4,180	59%
												1966-2015 avg	17,845	6,293	

ATTACHMENT 5

Estimated CVP Operations 50% Exceedance

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity	2024	2011	1981	1930	1800	1675	1521	1369	1334	1321	1351	1406	1516
	Elev.	2342	2340	2336	2327	2317	2305	2292	2289	2288	2290	2295	2305
Whiskeytown	205	206	238	238	238	238	238	238	206	206	206	206	206
	Elev.	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199
Shasta	3546	3579	3717	3602	3169	2611	2190	2034	1945	2024	2169	2530	3070
	Elev.	1032	1037	1033	1015	990	968	959	954	959	967	986	1011
Folsom	447	429	495	535	510	373	333	296	279	280	318	377	556
	Elev.	407	416	421	418	399	393	386	383	384	390	400	423
New Melones	1930	1898	1860	1797	1713	1627	1557	1516	1488	1505	1529	1562	1617
	Elev.	1043	1039	1033	1025	1016	1009	1005	1002	1004	1006	1010	1015
San Luis	290	351	298	163	-46	-59	-36	55	194	390	611	812	965
	Elev.	473	463	434	387	365	347	355	390	422	457	484	502
Total		8474	8589	8265	7384	6466	5804	5507	5445	5725	6184	6893	7929

State End of the Month Reservoir Storage (TAF)

Oroville	2252	2308	2408	2260	2093	1830	1661	1609	1538	1501	1546	1718	2069
	Elev.	810	819	806	791	766	748	743	735	731	736	755	789
San Luis	930	879	808	651	472	334	207	158	254	316	429	520	567
Total San Luis (TAF)	1220	1230	1106	815	426	276	171	213	448	706	1040	1333	1531

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	36	92	47	28	53	52	23	18	18	18	17
	cfs	300	600	1,498	783	450	857	870	373	300	300	300	300
Clear Creek	TAF	12	13	23	17	9	9	9	12	12	12	25	11
	cfs	200	218	380	288	150	150	150	200	200	200	400	200
Sacramento	TAF	295	387	492	744	830	676	416	369	238	246	246	222
	cfs	4800	6500	8000	12500	13500	11000	7000	6000	4000	4000	4000	4000
American	TAF	98	89	101	89	187	92	89	92	89	74	92	83
	cfs	1600	1500	1644	1501	3042	1500	1500	1504	1500	1200	1500	1500
Stanislaus	TAF	31	29	25	9	9	9	9	35	12	12	13	12
	cfs	500	480	410	150	150	150	150	577	200	200	213	214
Feather	TAF	114	62	65	63	200	175	111	99	75	78	108	97
	cfs	1850	1049	1060	1060	3260	2850	1865	1610	1260	1270	1750	1750

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	36	111	49	101	99	100	99	23	25	9	10	2
Spring Crk. PP	60	90	40	90	90	90	90	45	20	12	19.8	35

Delta Summary (TAF)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy		160	56	46	45	260	260	260	265	250	255	235	220
USBR Banks		0	0	0	0	7	7	7	0	0	0	0	0
Contra Costa		12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0
Total USBR		173	69	59	55	278	280	281	282	268	273	249	234
State Export		80	48	18	20	71	66	106	236	174	215	160	150
Total Export		253	116	77	75	349	346	387	518	442	488	409	384
COA Balance		0	-10	-74	4	56	56	56	90	19	19	19	19
Vernalis	TAF	76	118	124	56	48	46	51	104	83	83	92	111
Vernalis	cfs	1232	1980	2010	940	784	752	856	1700	1393	1355	1498	1997
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-3,201	-1,203	-653	-1,135	-4,610	-4,582	-5,214	-6,311	-5,689	-6,097	-5,039	-5,016
Computed DOI		7938	8253	7597	7346	4994	3595	3110	4002	4505	8296	15259	19505
Excess Outflow		0	0	0	0	0	98	101	0	0	3790	10753	8105
% Export/Inflow		33%	15%	10%	9%	37%	42%	52%	59%	57%	48%	31%	26%
% Export/Inflow std.		35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	499		3,453		1,227		577	
Year to Date + Forecasted % of mean	41%		62%		45%		55%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

3/25/2020

Estimated CVP Operations 90% Exceedance
Assumes Shasta Non-Critical, 15% Ag, 65% M, 50% NoD

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity	2024	1991	1900	1756	1615	1485	1328	1173	1132	1097	1079	1077	1105
	Elev.	2340	2334	2323	2312	2302	2288	2274	2269	2266	2264	2264	2267
Whiskeytown	205	206	238	238	238	238	238	238	206	206	206	206	206
	Elev.	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199
Shasta	3546	3579	3565	3384	2932	2453	2075	1879	1781	1806	1861	1973	2139
	Elev.	1032	1031	1024	1005	982	962	950	944	946	949	956	985
Folsom	447	449	495	492	433	341	271	250	251	255	271	295	345
	Elev.	410	416	415	408	394	382	378	378	379	382	386	395
New Melones	1930	1891	1835	1742	1650	1561	1488	1443	1406	1407	1411	1415	1415
	Elev.	1042	1037	1028	1019	1010	1002	997	993	993	993	994	994
San Luis	290	338	285	151	-26	-192	-230	-145	-81	-81	2	198	176
	Elev.	473	463	442	415	382	367	376	391	408	438	466	453
Total		8454	8318	7762	6842	5887	5170	4838	4694	4690	4830	5165	5385

State End of the Month Reservoir Storage (TAF)

Oroville	2252	2269	2267	2034	1775	1442	1204	1144	1051	941	886	957	1104
	Elev.	807	807	786	760	724	693	685	672	655	646	658	680
San Luis	930	887	818	739	673	578	513	488	534	668	856	940	827
Total San Luis (TAF)	1220	1226	1103	890	647	387	284	343	453	587	859	1138	1003

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	36	92	47	28	53	52	23	18	18	18	17
	cfs	300	600	1,498	783	450	857	870	373	300	300	300	300
Clear Creek	TAF	17	12	12	12	9	9	9	12	12	12	12	11
	cfs	275	200	200	200	150	150	150	200	200	200	200	200
Sacramento	TAF	295	434	523	708	707	599	416	338	223	215	215	222
	cfs	4800	7300	8500	11900	11500	9750	7000	5500	3750	3500	3500	4000
American	TAF	92	84	86	107	136	111	60	40	39	40	40	56
	cfs	1500	1413	1406	1800	2210	1808	1010	658	654	650	650	1000
Stanislaus	TAF	37	29	25	9	9	9	9	35	12	12	13	12
	cfs	600	480	410	150	150	150	150	577	200	200	213	214
Feather	TAF	113	90	142	128	214	185	112	82	58	59	58	53
	cfs	1840	1513	2313	2151	3480	3009	1882	1334	973	960	950	950

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	58	119	96	100	100	101	100	24	30	21	15	10
Spring Crk. PP	60	90	90	90	90	90	90	45	20	12	10	10

Delta Summary (TAF)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy		147	57	46	78	107	199	255	190	54	117	230	45
USBR Banks		0	0	0	0	7	7	7	0	0	0	0	0
Contra Costa		3.4	3.8	4.2	5.1	5.6	5.5	4.2	4.2	3.8	3.8	3.8	3.0
Total USBR		150	60	50	83	120	212	266	194	58	121	234	48
State Export		99	24	18	66	42	62	60	102	158	196	160	26
Total Export		249	84	69	149	162	274	326	296	216	317	394	74
COA Balance		0	6	-56	0	0	0	16	0	0	-1	-1	-1
Vernalis	TAF	82	88	87	40	42	37	43	104	83	83	92	82
Vernalis	cfs	1332	1480	1410	671	687	605	722	1700	1393	1355	1498	1475
Old/Middle River Std.													
Old/Middle R. calc.		-3,114	-1,017	-817	-2,218	-2,305	-3,744	-4,488	-3,536	-2,757	-3,949	-4,849	-952
Computed DOI		7938	7682	7597	6152	4994	3497	3009	4002	4505	4506	6474	11599
Excess Outflow		0	0	0	0	0	0	0	0	0	0	1968	198
% Export/Inflow		34%	13%	10%	21%	22%	37%	49%	46%	41%	54%	53%	10%
% Export/Inflow std.		35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	380		3,088		1,065		510	
Year to Date + Forecasted % of mean	31%		56%		39%		48%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

3/24/2020

ATTACHMENT 6

United States Department of the Interior

BUREAU OF RECLAMATION
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825-1898

IN REPLY REFER TO:

CGB-1000
2.2.4.21

MAR 13 2020

Memorandum

To: Regional Director
U.S. Fish and Wildlife Service, Interior Region 10

From: Ernest A. Conant
Regional Director Acting for

Subject: Long-Term Operation (LTO) of the Central Valley Project (CVP) and State Water Project (SWP), Additional Real-Time Old and Middle River (OMR) Flow Restrictions for Delta Smelt Larval and Juvenile Entrainment for 2019

The October 2019 Proposed Action for the LTO calls for Reclamation and DWR to manage exports to limit entrainment to be protective of larval and juvenile delta smelt on or after March 15 of each year, if QWEST is negative, and larval or juvenile delta smelt are within the entrainment zone of the pumps based on real-time sampling of spawning adults or young of year life stages. The 2019 Fish and Wildlife Service Biological Opinion permits incidental take through entrainment during March-June, under the ecological conditions of OMR flows managed at no more negative than -5000 cfs on a 14-day moving average or at the flow determined through use of Service-approved life cycle models to limit recruitment to stable levels. Reasonable and Prudent Measure 1, Term and Condition 6 requires Reclamation and DWR to use Service life cycle models or other Service-approved models when available for the purposes of estimating proportion of the population affected by entrainment.

Reclamation coordinated with the Service on the Life Cycle Model entrainment module and proposes to operationalize results through the management of OMR reverse flows. When the secchi depth in the south Delta is less than 1 meter, as determined by the weekly assessments based on Enhanced Delta Smelt Monitoring (EDSM) and other available data, Reclamation will operate to OMR no more negative than -3,500 cfs. When the secchi depth in the south Delta is greater than 1 meter, Reclamation and DWR will operate to OMR no more negative than -5,000 cfs. Reclamation and DWR shall prepare weekly assessments and coordinate with the Service through the smelt monitoring team. The assessments may consider real-time monitoring for the spatial distribution of Delta Smelt, hydrodynamic models, forecasts of entrainment, and other information to propose an alternative OMR between -3,500 and -5,000 cfs or more negative OMR during storm-related events. Reclamation and DWR shall finalize weekly assessments at the Water Operations Management Team (WOMT). If, after WOMT, Service representatives on

WOMT find the assessments are not technically sufficient, are not consistent with the analyzed effects of the Proposed Action and Incidental Take Statements, and/or do not consider a reasonable operation allowable under the Proposed Action, the Service may elevate the assessment to the Regional Directors of the Service and Reclamation.

I appreciate your ongoing efforts and those of your staff to coordinate on the operation of the CVP and SWP. Please let me know if you have concerns with this approach for water year 2020 and beyond, unless and until superseded by an updated memorandum. We look forward to working with you on potential improvements and refinements over the next year.

Attachment

DRAFT

DSM TN 47. Predictions of Delta Smelt entrainment mortality for conservation planning

William Smith, 2 March 2020

The objective of this exercise was to predict proportional entrainment mortality of Delta Smelt as a function of Old and Middle River flow and South Delta Secchi depth.

Methods

Monte Carlo simulations were used to predict expected values of proportional entrainment mortality u_s for early and late postlarval lifestages s (PL1 and PL2) of Delta Smelt, given a set of Old and Middle River flow (OMR) and South Delta Secchi depth (Secchi) conditions and Delta Smelt population dynamics parameters from the fitted Life Cycle Model with Entrainment (LCME, Smith et al. 2019). In each iteration of the Monte Carlo simulation, random values of parameters γ, β, σ_F and σ_M, defined below, were drawn from their joint posterior distribution estimated during fitting of the LCME. This process was iterated 40,000 times, and the distribution of u_s calculated from these random values for a given set of OMR and Secchi values represented both parameter and process uncertainty. Representation of critical uncertainties facilitated a probabilistic approach to risk assessment.

u_s was calculated from instantaneous rates of entrainment mortality F and natural mortality M

$$u_s = \frac{F_s*\left(1-e^{-(F_s+M_s)}\right)}{(F_s+M_s)}.$$

Expected values of F depended on environmental conditions and regression parameters γ, and expected values of M depended on expected mean weight W_s, environmental conditions (mean June-August *Outflow*), and regression parameters β. In order to account for uncertainty in F and M, stochastic F and M were simulated from lognormal distributions

$$F_s \sim \text{Lognormal}\left(\left(\gamma_{0,s} + \gamma_{1,s} * OMR + \gamma_{2,s} * Secchi + \gamma_{3,s} * OMR * Secchi\right), \sigma_F\right),$$

$$M_{PL1} \sim \text{Lognormal}\left(\left(\beta_0 + \beta_1 * W_{PL1}\right), \sigma_M\right), \text{ and}$$

$$M_{PL2} \sim \text{Lognormal}\left(\left(\beta_0 + \beta_1 * W_{PL2} + \beta_3 * Outflow\right), \sigma_M\right).$$

where the parameters σ_F and σ_M were the standard deviation parameters describing process variation.

As the value $(\beta_0 + \beta_1 * W_{PL1})$ did not vary, expected values of M_{PL1} were calculated from an intercept-only model, while expected values of M_{PL2} were calculated as a function of 2002-2015 mean June-August outflow. Sensitivity analysis using the 2002-2015 minimum June-August outflow indicated that values of u_s were insensitive to this choice. As M_{PL2} represented a 2-3 month mortality value, while F_{PL2} (and therefore u_{PL2}) represented a single month at the beginning of the period beginning in June and ending in August, M_{PL2} was divided by three when calculating u_{PL2}.

Both OMR and Secchi disk depths in the south Delta affect entrainment predictions in LCME. Therefore, two sets of simulations were performed. One set a fixed value for Secchi depth and allowed OMR to vary across a wide range of values, and the second set fixed OMR at -6,500ft^3 and allowed Secchi to vary across a wide range of values. A target was defined at $u = 0.10$, and predictions were compared to this value. A precautionary approach was used to define risk tolerance, where risk was the probability that the target was exceeded. A risk tolerance of 25% (risk of exceeding target = 25%) was defined, so the upper quantiles of the posterior distributions of predicted u (25% of posterior density > reported value) were reported. This means that there is a 25% chance the target is exceeded at the OMR and Secchi conditions specified or a 100% minus 25% = 75% chance a target would not be exceeded under the specified conditions.

Results

Delta Smelt Life Cycle Model results are presented in Table 1 and Figure 1 to provide context for the mortality predictions generated in this Technical Note. During the period of highest entrainment mortality, 1999-2003, estimates of proportional entrainment mortality (posterior means) across early and late post-larval life stages (April-June) ranged 0.08-0.18 (8% to 18%) per year. In subsequent years 2004-2015, proportional entrainment mortality declined substantially, ranging 0.001-0.03 (0.1% to 3% per year). Most of the cumulative April-June entrainment mortality appeared to occur in April-May when fish are smaller on average. Average April-May and June OMR reached minimal (most negative) values during the same 1999-2003 period that entrainment mortality peaked, but average OMR was generally higher (less negative) subsequent to 2005. South Delta Secchi depths increased over the 1995-2015 time period (Fig. 2).

At the lowest levels of Secchi depth, which represent the most turbid water conditions (Fig. 2; 61cm) observed during 2007-2015, the upper quartile of cumulative April-June proportional entrainment mortality was predicted to increase from 0.05 to 0.10 (5% to 10%) over an OMR range of approximately -2,450 to -5,500ft^3 (Table 2; Fig. 3). In contrast, at the median 2007-2015 Secchi depth (99cm), the same change in the upper quartile of proportional entrainment mortality occurred over an OMR range of approximately -5,600 to -9,250ft^3. Using a negative OMR assumption of -6,500ft^3 (i.e., lower than the 2007-2015 minimum of -4,664ft^3; Fig. 4) the upper quartile of cumulative April-June proportional entrainment mortality increased from 0.05 to 0.10 (5% to 10%) at Secchi depths near the 2007-2015 median (Table 3).

Discussion

Target values of proportional entrainment mortality u representing a sustainable level of entrainment mortality cannot be defined given current Delta Smelt population dynamics. Defining a sustainable level of entrainment would require excess production of delta smelt. Collection of datasets used to fit the Delta Smelt Life Cycle Model only began in 1995, after the Delta Smelt was listed as a threatened species, in decline, and no longer generated excess production. The delta smelt population has declined for several reasons; thus, even if it were possible to achieve entrainment mortality of 0, it would not likely result in population growth.

Flexibility in managing entrainment risk

The value u represents the combination of two competing source of mortality. Importantly, as natural mortality increases, the same number of entrained individuals results in increasingly greater entrainment mortality. A dynamic strategy to evaluating future entrainment risk could include some consideration of natural mortality. In years when high natural mortality rates are expected, target u will occur at slightly less negative OMR, while in years when low natural mortality is expected, target u will occur at slightly more negative OMR. Unfortunately, the current configuration of the Delta Smelt Life Cycle Model does not include covariates for early post-larval natural mortality, which could be used to identify high and low mortality conditions.

The Life Cycle Model does include June-August outflow as a covariate for late post-larval natural mortality, but most natural mortality is expected to occur after entrainment (June) during this seasonal period (June-August). Historically, only a small fraction of the total cumulative entrainment mortality has occurred in June, and predicted June u was not sensitive to the value of natural mortality. In other words, consideration of late post-larval (summer) natural mortality is unlikely to lead to greater flexibility in defining conservation thresholds for OMR management, while identification of early post-larval natural mortality covariates could leverage greater flexibility.

Literature Cited

Smith, W.E., Polanksy, L.P., and Nobriga, M.N. 2019. Disentangling trends in entrainment and natural mortality an endangered estuarine fish using a stage-structured population model. Final report submitted to California Department of Water Resources under the Delta Smelt Life Cycle Model grant.

Table 1. Posterior summaries of proportional entrainment mortality estimated for Delta Smelt post-larvae during years 1995-2015. Median posterior values are listed, and 95% credible intervals are shown in parentheses. Early post-larvae represents the April-May time period, late post-larvae represents the June time period, and all post-larvae represents the cumulative April-June total.

Year	Early post-larvae	Late post-larvae	All postlarvae
1995	0.0032(0.0005-0.0192)	0.0002($4.1e^{-5}$-0.0007)	0.0032(0.0006-0.0185)
1996	0.0404(0.0117-0.1332)	0.0029(0.001-0.0086)	0.0327(0.0106-0.104)
1997	0.0508(0.0146-0.1564)	0.004 (0.0016-0.0098)	0.0372(0.0126-0.1098)
1998	0.0022(0.0003-0.0155)	0.0005(0.0001-0.0035)	0.0025(0.0004-0.0149)
1999	0.1343(0.0417-0.4016)	0.0214(0.0091-0.0501)	0.1304(0.0475-0.3605)
2000	0.1444(0.0435-0.4412)	0.0074(0.0028-0.0192)	0.1091(0.0368-0.3327)
2001	0.0884(0.0285-0.2595)	0.0106(0.0037-0.0304)	0.0812(0.0298-0.2245)
2002	0.2488(0.0867-0.6352)	0.0075(0.0028-0.0201)	0.1838(0.0676-0.491)
2003	0.1655(0.0517-0.4782)	0.0108(0.0039-0.0302)	0.1235(0.0434-0.3557)
2004	0.0406(0.0096-0.1451)	0.006 (0.0025-0.0145)	0.0296(0.0093-0.0945)
2005	0.0091(0.0024-0.0328)	0.0012(0.0004-0.0038)	0.0072(0.0024-0.0235)
2006	0.0024(0.0004-0.0145)	0.0002($3.7e^{-5}$-0.0007)	0.0013(0.0003-0.007)
2007	0.0129(0.003-0.0486)	0.0025(0.001-0.0064)	0.0093(0.0031-0.0304)
2008	0.0186(0.0045-0.0696)	0.0016(0.0005-0.0045)	0.0128(0.0038-0.0448)
2009	0.0074(0.0021-0.0256)	0.001 (0.0004-0.0026)	0.0046(0.0017-0.0136)
2010	0.0038(0.0008-0.0163)	0.0001($2.3e^{-5}$-0.0004)	0.0026(0.0006-0.0109)
2011	0.0076(0.0011-0.0505)	0.0002(0.0001-0.0009)	0.007 (0.0012-0.0454)
2012	0.0301(0.0087-0.099)	0.0013(0.0005-0.0033)	0.0185(0.0063-0.0585)
2013	0.0209(0.0063-0.0655)	0.0002(0.0001-0.0007)	0.0132(0.0041-0.0419)
2014	0.0061(0.0013-0.0264)	0.000041($1.0e^{-5}$-0.0002)	0.0041(0.0009-0.0173)
2015	0.0266(0.0069-0.0979)	0.0001($3.7e^{-5}$-0.0006)	0.015 (0.004-0.0566)

Table 2. Upper quantiles of predicted entrainment mortality (1/4 of predictions above reported value, 3/4 of predictions below) at the minimum and median levels of Secchi depth observed during April-June during 2007-2015, over a range of Old and Middle River flow (OMR). Entrainment mortality for two life stages (PL1, PL2; early and late post-larval) and the combination of both life stages are presented.

OMR	Low secchi = 61cm			Median secchi = 99cm		
	Early post-larvae	Late post-larvae	All postlarvae	Early post-larvae	Late post-larvae	All postlarvae
-10,237	0.351	0.008	0.253	0.170	0.003	0.117
-9,899	0.332	0.008	0.238	0.158	0.003	0.110
-9,560	0.314	0.007	0.225	0.150	0.003	0.105
-9,221	0.295	0.006	0.210	0.141	0.003	0.098
-8,883	0.280	0.006	0.199	0.132	0.003	0.092
-8,544	0.263	0.005	0.185	0.124	0.002	0.086
-8,206	0.243	0.005	0.171	0.116	0.002	0.081
-7,867	0.224	0.005	0.157	0.111	0.002	0.076
-7,529	0.215	0.004	0.150	0.104	0.002	0.072
-7,190	0.201	0.004	0.140	0.097	0.002	0.067
-6,852	0.185	0.004	0.128	0.092	0.002	0.064
-6,513	0.174	0.003	0.121	0.086	0.002	0.059
-6,174	0.161	0.003	0.113	0.081	0.002	0.056
-5,836	0.150	0.003	0.103	0.076	0.001	0.052
-5,497	0.138	0.003	0.097	0.071	0.001	0.049
-5,159	0.131	0.003	0.091	0.068	0.001	0.046
-4,820	0.122	0.002	0.085	0.064	0.001	0.044
-4,482	0.113	0.002	0.078	0.060	0.001	0.041
-4,143	0.105	0.002	0.072	0.057	0.001	0.039
-3,805	0.099	0.002	0.068	0.053	0.001	0.036
-3,466	0.092	0.002	0.063	0.050	0.001	0.035
-3,128	0.085	0.002	0.059	0.048	0.001	0.033
-2,789	0.078	0.002	0.054	0.045	0.001	0.031
-2,450	0.073	0.001	0.051	0.042	0.001	0.029
-2,112	0.068	0.001	0.047	0.040	0.001	0.027
-1,773	0.065	0.001	0.044	0.037	0.001	0.026
-1,435	0.059	0.001	0.040	0.036	0.001	0.025
-1,096	0.055	0.001	0.038	0.034	0.001	0.023
-758	0.051	0.001	0.035	0.032	0.001	0.022
-419	0.048	0.001	0.033	0.031	0.001	0.021
-81	0.044	0.001	0.031	0.029	0.001	0.020
258	0.042	0.001	0.029	0.027	0.001	0.019
596	0.039	0.001	0.026	0.026	0.000	0.018
935	0.036	0.001	0.025	0.024	0.000	0.017
1,274	0.034	0.001	0.023	0.024	0.000	0.016
1,612	0.032	0.001	0.022	0.022	0.000	0.015
1,951	0.030	0.001	0.020	0.021	0.000	0.014
2,289	0.027	0.001	0.019	0.020	0.000	0.014
2,628	0.026	0.000	0.017	0.019	0.000	0.013
2,966	0.024	0.000	0.017	0.018	0.000	0.013
3,305	0.022	0.000	0.015	0.017	0.000	0.012
3,643	0.021	0.000	0.014	0.017	0.000	0.011
3,982	0.020	0.000	0.014	0.016	0.000	0.011
4,321	0.018	0.000	0.012	0.015	0.000	0.010
4,659	0.017	0.000	0.012	0.014	0.000	0.010
4,998	0.016	0.000	0.011	0.014	0.000	0.009
5,336	0.015	0.000	0.010	0.013	0.000	0.009
5,675	0.014	0.000	0.009	0.013	0.000	0.009
6,013	0.013	0.000	0.009	0.012	0.000	0.008
6,352	0.012	0.000	0.008	0.012	0.000	0.008

Color coding

proportion F >= 0.1

proportion F between 0.05 and 0.1

proportion F <= 0.05

Table 3. Upper quantiles of predicted entrainment mortality (1/4 of predictions above reported value, 3/4 of predictions below) at a low level of Old and Middle River flow (OMR), over a range of secchi depth. Entrainment mortality for two life stages (PL1, PL2; early and late post-larval) and the combination of both life stages are presented.

South Delta Secchi	OMR=-6,500ft³		
	Early post-larvae	Late post-larvae	All postlarvae
35.9	0.885	0.069	0.775
37.9	0.869	0.063	0.752
39.8	0.851	0.055	0.723
41.7	0.833	0.048	0.700
43.6	0.813	0.043	0.675
45.5	0.786	0.038	0.644
47.5	0.755	0.034	0.610
49.4	0.731	0.030	0.584
51.3	0.697	0.027	0.547
53.2	0.664	0.024	0.521
55.1	0.633	0.021	0.487
57.1	0.597	0.019	0.452
59.0	0.563	0.017	0.423
60.9	0.526	0.015	0.393
62.8	0.493	0.013	0.361
64.7	0.455	0.012	0.334
66.7	0.421	0.011	0.308
68.6	0.387	0.009	0.281
70.5	0.358	0.008	0.260
72.4	0.329	0.008	0.236
74.3	0.303	0.007	0.215
76.3	0.276	0.006	0.195
78.2	0.251	0.005	0.176
80.1	0.227	0.005	0.160
82.0	0.207	0.004	0.145
83.9	0.191	0.004	0.133
85.9	0.170	0.003	0.119
87.8	0.156	0.003	0.108
89.7	0.142	0.003	0.098
91.6	0.127	0.002	0.088
93.5	0.115	0.002	0.079
95.5	0.105	0.002	0.073
97.4	0.094	0.002	0.065
99.3	0.085	0.002	0.059
101.2	0.078	0.001	0.053
103.1	0.070	0.001	0.048
105.1	0.062	0.001	0.043
107.0	0.057	0.001	0.039
108.9	0.051	0.001	0.035
110.8	0.047	0.001	0.032
112.7	0.041	0.001	0.029
114.7	0.038	0.001	0.026
116.6	0.035	0.001	0.024
118.5	0.031	0.001	0.021
120.4	0.028	0.001	0.019
122.3	0.025	0.000	0.017
124.3	0.023	0.000	0.015
126.2	0.020	0.000	0.014
128.1	0.019	0.000	0.013
130.0	0.017	0.000	0.012

Color coding

proportion F >= 0.1

proportion F between 0.05 and 0.1

proportion F <= 0.05

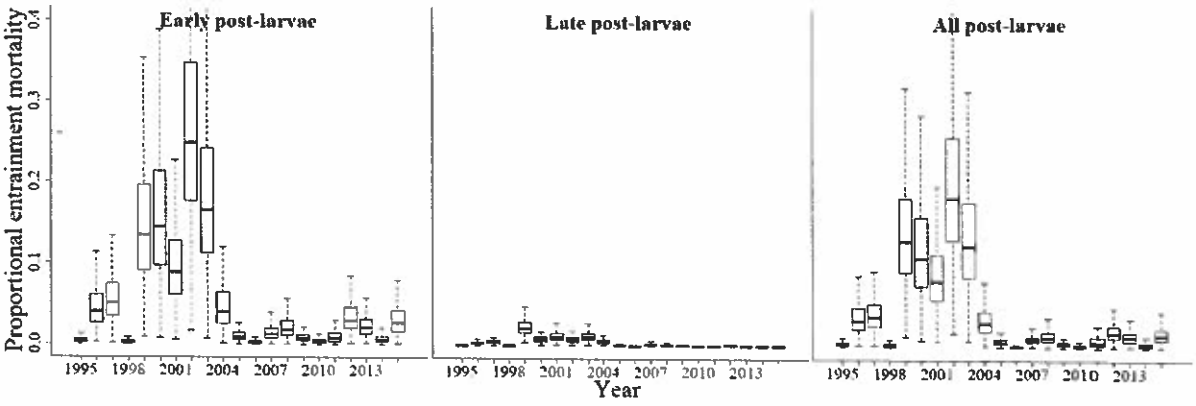

Figure 1. Time series of post-larval proportional entrainment posterior distributions from the fitted Delta Smelt Life Cycle Model. Early post-larvae represents the April-May time period, late post-larvae represents the June time period, and all post-larvae represents the cumulative April-June total.

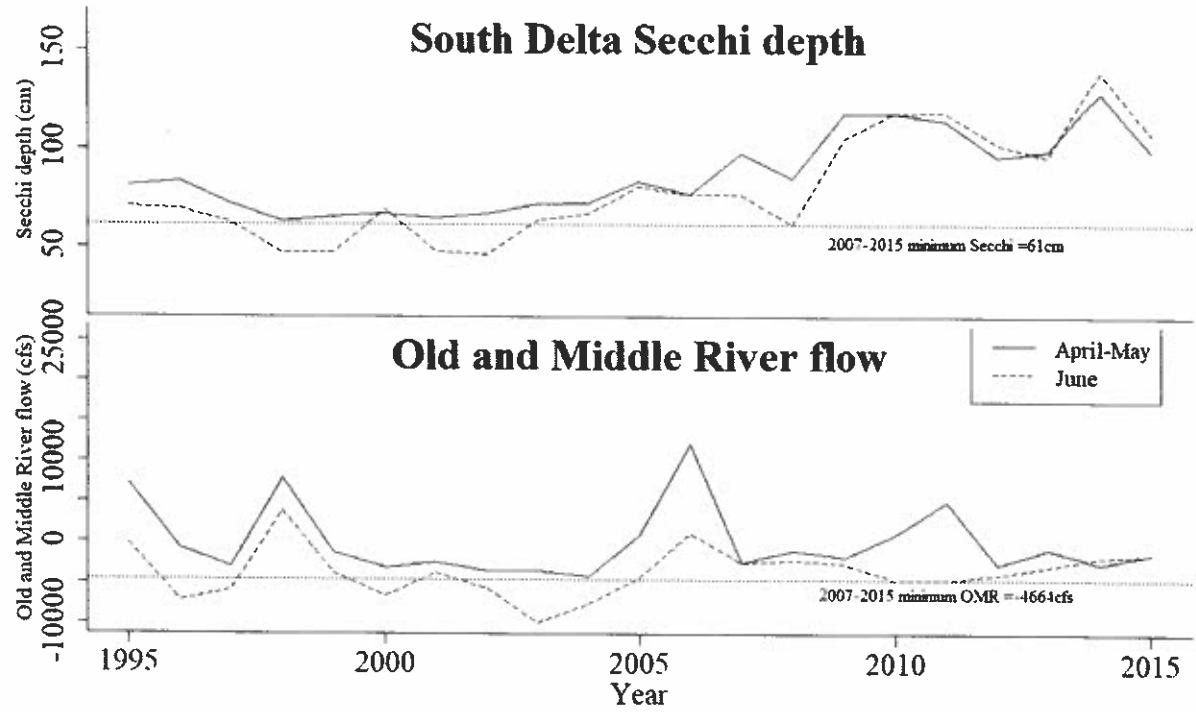

Figure 2. Time series of post-larval entrainment variables used to fit the Delta Smelt Life Cycle Model with Entrainment.

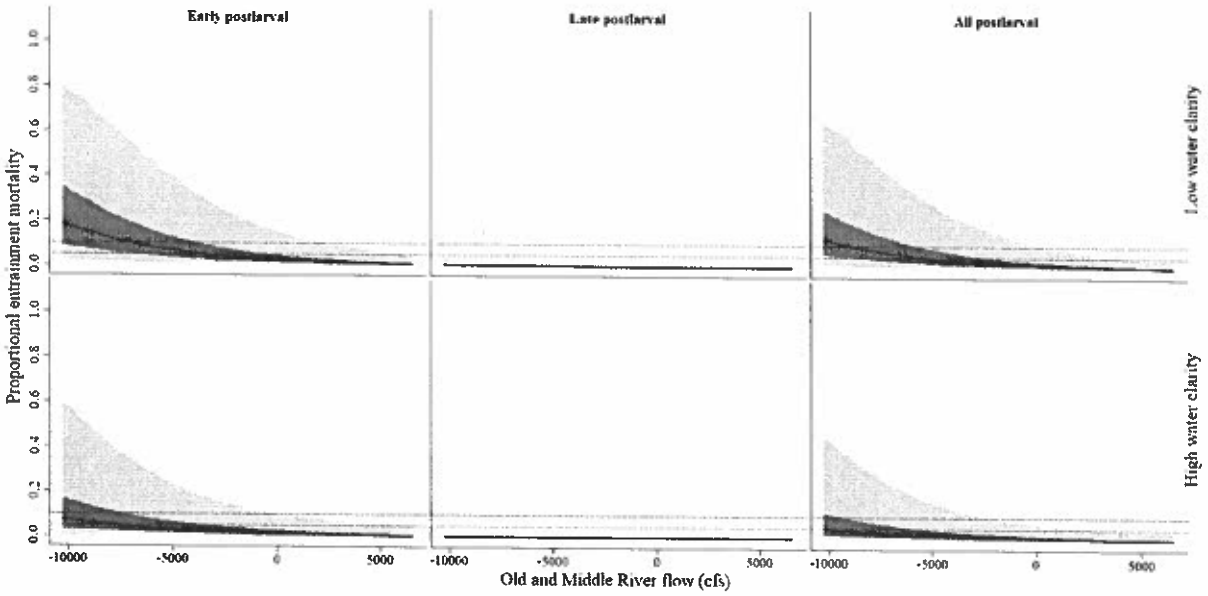

Figure 3. Predicted proportional entrainment mortality at the minimum (upper panels) and median (lower panels) levels of secchi depth observed during April-June during 2007-2015. Dotted reference lines show mortality values of 0.10 and 0.05. The solid black line indicates the medians of predicted proportional entrainment mortality, the dark gray bands indicate the interquartile ranges of proportional entrainment mortality, and the light gray bands indicate the 95% credible intervals. The upper edge of the gray bands correspond to the upper quantile of predicted proportional entrainment mortality that were used to define the limit of exceedance probability.

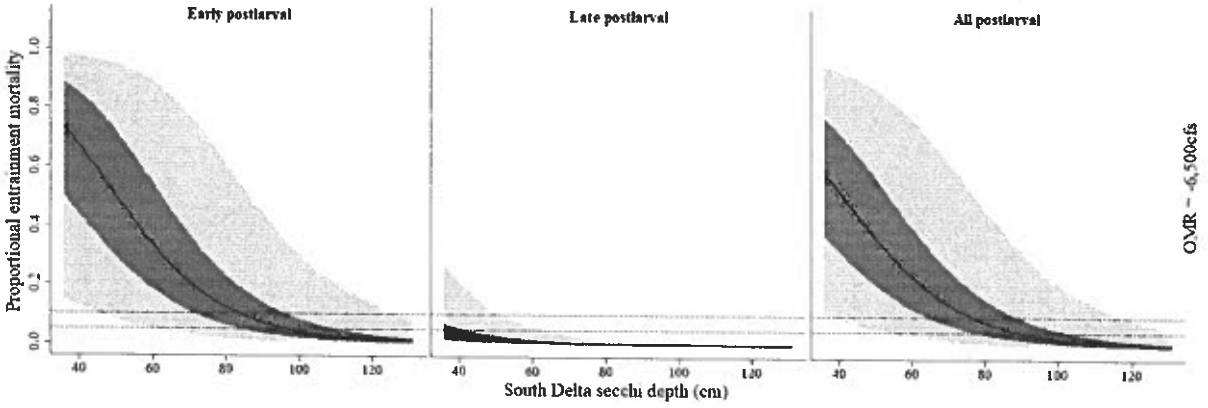

Figure 4. Predicted proportional entrainment mortality at a low level of OMR, across a range of South Delta Secchi depths. Dotted reference lines show mortality values of 0.10 and 0.05. The solid black line indicates the medians of predicted proportional entrainment mortality, the dark gray bands indicate the interquartile ranges of proportional entrainment mortality, and the light gray bands indicate the 95% credible intervals.